

# Package ‘pricesensitivitymeter’

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**Type** Package

**Title** Van Westendorp Price Sensitivity Meter Analysis

**Version** 0.4.1

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**Description** An implementation of the van Westendorp Price Sensitivity Meter in R, which is a survey-based approach to analyze consumer price preferences and sensitivity (van Westendorp 1976, isbn:9789283100386).

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**LazyData** true

**Encoding** UTF-8

**BugReports** <https://github.com/alletsee/pricesensitivitymeter/issues>

**URL** <https://github.com/alletsee/pricesensitivitymeter>

**Depends** R (>= 3.0.0), methods

**Suggests** knitr, rmarkdown, testthat, ggplot2

**VignetteBuilder** knitr

**NeedsCompilation** no

**Author** Max Alletsee [aut, cre]

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pricesensitivitymeter *Consumer Price Preferences and Price Sensitivity Analysis*

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### Description

pricesensitivitymeter is an implementation of the van Westendorp Price Sensitivity Meter method to analyze consumer price preferences and price sensitivity in R. Besides the estimation of optimal price points and price ranges, it can also model the optimal price in terms of reach or revenue (based on the so-called Newton Miller Smith extension).

To read the documentation for the function's syntax, see [psm\\_analysis](#).

### Author(s)

Max Alletsee <max.alletsee@gmail.com>

### References

Van Westendorp, P (1976) "NSS-Price Sensitivity Meter (PSM) – A new approach to study consumer perception of price" *Proceedings of the 29th ESOMAR Congress*, 139–167. Online available at <https://rwconnect.esomar.org/a-new-approach-to-study-consumer-perception-of-price/>.

Newton, D, Miller, J, Smith, P, (1993) "A market acceptance extension to traditional price sensitivity measurement" *Proceedings of the American Marketing Association Advanced Research Techniques Forum*.

### See Also

Useful links:

- <https://github.com/alletsee/pricesensitivitymeter>
- Report bugs at <https://github.com/alletsee/pricesensitivitymeter/issues>

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psm-class

Class "psm"

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### Description

Class "psm" is a class for outputs of Price Sensitivity Meter analyses as performed by the [psm\\_analysis](#) function.

The main purpose is to create a custom summary function for objects of class "psm".

### Objects from the Class

Objects are usually created as a result of a call of the [psm\\_analysis](#) function.

## Slots

- data\_input:** Object of class "data.frame". Contains the data that was used as an input for the analysis.
- validated:** Object of class "logical". Indicates whether the "validate" option of the `psm_analysis` function has been used (to exclude cases with intransitive price preferences).
- invalid\_cases:** Object of class "numeric". Number of cases with intransitive price preferences.
- total\_sample:** Object of class "numeric". Total sample size of the input sample *before* assessing the transitivity of individual price preferences.
- data\_vanwestendorp:** Object of class "data.frame". Output data of the Price Sensitivity Meter analysis. Contains the cumulative distribution functions for the four price assessments (too cheap, cheap, expensive, too expensive) for all prices as well as the inversed distributions "not cheap" and "not expensive" (that are required for the acceptable price range).
- pricerange\_lower:** Object of class "numeric". Lower limit of the acceptable price range as defined by the Price Sensitivity Meter, also known as **point of marginal cheapness**: Intersection of the "too cheap" and the "not cheap" curves.
- pricerange\_upper:** Object of class "numeric". Upper limit of the acceptable price range as defined by the Price Sensitivity Meter, also known as **point of marginal expensiveness**: Intersection of the "too expensive" and the "not expensive" curves.
- idp:** Object of class "numeric". **Indifference Price Point** as defined by the Price Sensitivity Meter: Intersection of the "cheap" and the "expensive" curves.
- opp:** Object of class "numeric". **Optimal Price Point** as defined by the Price Sensitivity Meter: Intersection of the "too cheap" and the "too expensive" curves.
- NMS:** Object of class "logical". Indicates whether the additional analyses of the Newton Miller Smith Extension were performed.
- data\_nms:** Object of class "data.frame". Output of the Newton Miller Smith extension: calibrated mean purchase probabilities for each price point.
- pi\_scale:** Object of class "data.frame". Shows the values of the purchase intent variable and the corresponding calibrated purchase probabilities as defined in the function input for the Newton Miller Smith extension.
- price\_optimal\_trial:** Object of class "numeric". Output of the Newton Miller Smith extension: Estimate for the price with the highest trial rate.
- price\_optimal\_revenue:** Object of class "numeric". Output of the Newton Miller Smith extension: Estimate for the price with the highest revenue (based on the trial rate).

## Methods

[summary.psm](#)

## References

- Van Westendorp, P (1976) "NSS-Price Sensitivity Meter (PSM) – A new approach to study consumer perception of price" *Proceedings of the 29th ESOMAR Congress*, 139–167. Online available at <https://rwconnect.esomar.org/a-new-approach-to-study-consumer-perception-of-price/>.
- Newton, D, Miller, J, Smith, P, (1993) "A market acceptance extension to traditional price sensitivity measurement" *Proceedings of the American Marketing Association Advanced Research Techniques Forum*.

## See Also

To understand the main function that creates an object of class "psm", see [psm\\_analysis](#).

To understand how the summaries of objects of class "psm" look like, see [summary.psm](#)

## Examples

```
showClass("psm")
```

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psm\_analysis

*Van Westendorp Price Sensitivity Meter Analysis (PSM)*

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## Description

`psm_analysis()` performs an analysis of consumer price preferences and price sensitivity known as **van Westendorp Price Sensitivity Meter (PSM)**. It takes respondent's price preferences (from survey data) as an input and estimates acceptable price ranges and price points. For a description of the method see the *Details* section.

## Usage

```
psm_analysis(  
  toocheap, cheap, expensive, tooexpensive,  
  data = NA,  
  validate = TRUE,  
  interpolate = FALSE,  
  pi_cheap = NA, pi_expensive = NA,  
  pi_scale = 5:1,  
  pi_calibrated = c(0.7, 0.5, 0.3, 0.1, 0))
```

## Arguments

`toocheap`, `cheap`, `expensive`, `tooexpensive`

If a `data.frame/matrix` is provided in the `data` argument: names of the variables in the `data.frame/matrix` that contain the survey data on the respondents' "too cheap", "cheap", "expensive" and "too expensive" price preferences.

If no `data.frame/matrix` is provided in the `data` argument: numeric vectors that directly include this information. If numeric vectors are provided, it is assumed that they are sorted by respondent ID (the preferences for respondent  $n$  are stored at the  $n$ -th position in all vectors).

If the `toocheap` price was not assessed, a variable/vector of NAs can be used instead. This variable/vector needs to have the same length as the other survey information. If `toocheap` is NA for all cases, it is possible to calculate the Point of Marginal Expensiveness and the Indifference Price Point, but it is impossible to calculate the Point of Marginal Cheapness and the Optimal Price Point.

data	data.frame or matrix that contains the function's input data. data input is not mandatory: Instead of using one data.frame/matrix as an input, it is also possible to provide the data directly as vectors in the "too cheap", "cheap", "expensive" and "too expensive" arguments.
validate	logical. should only respondents with consistent price preferences (too cheap < cheap < expensive < too expensive) be considered in the analysis?
interpolate	logical. should interpolation of the price curves be applied between the actual prices given by the respondents? If interpolation is enabled, the output appears less bumpy in regions with sparse price information. If the sample size is sufficiently large, interpolation should not be necessary.
pi_cheap, pi_expensive	Only required for the Newton Miller Smith extension. If data argument is provided: names of the variables in the data.frame/matrix that contain the survey data on the respondents' purchase intent at their individual cheap/expensive price.
pi_scale	Only required for the Newton Miller Smith extension. Scale of the purchase intent variables pi_cheap and pi_expensive. By default assuming a five-point scale with 5 indicating the highest purchase intent.
pi_calibrated	Only required for the Newton Miller Smith extension. Calibrated purchase probabilities that are assumed for each value of the purchase intent scale. Must be the same order as the pi_scale variable so that the first value of pi_calibrated corresponds to the first value in the pi_scale variable. Default values are taken from the Sawtooth Software PSM implementation in Excel: 70% for the best value of the purchase intent scale, 50% for the second best value, 30% for the third best value (middle of the scale), 10% for the fourth best value and 0% for the worst value.

## Details

The Price Sensitivity Meter method for the analysis of consumer price preferences was proposed by the Dutch economist Peter van Westendorp in 1976 at the ESOMAR conference. It is a survey-based approach that has become one of the standard price acceptance measurement techniques in the market research industry and is still widely used for during early-stage product development.

Price acceptance and price sensitivity are measured in van Westendorp's approach by four open-ended survey questions:

- At which price on this scale are you beginning to experience ... (test-product) as cheap?
- At which price on this scale are you beginning to experience ... (test-product) as expensive?
- At which price on this scale you are beginning to experience ... (test-product) as too expensive – so that you would never consider buying it yourself?
- At which price on this scale you are beginning to experience ... (test-product) as too cheap – so that you say "at this price the quality cannot be good"?

Respondents with inconsistent price preferences (e.g. "cheap" price larger than "expensive" price) are usually removed from the data set. This function has built-in checks to detect invalid preference structures and removes those respondents from the analysis by default.

To analyze price preferences and price sensitivity, the method uses cumulative distribution functions for each of the aforementioned price steps (e.g. "how many respondents think that a price of *x or more* is expensive?"). By convention, the distributions for the "too cheap" and the "cheap" price are inverted. This leads to the interpretation "how many respondents think that a price of *up to x* is (too) cheap?".

The interpretation is built on the analysis of the intersections of the four cumulative distribution functions for the different prices (usually via graphical inspection). The original paper describes the four intersections as follows:

- **Point of Marginal Cheapness (MGP):** Below this price point, there are more respondents that consider the price as "too cheap" than respondents who consider it as "not cheap" (intersection of "too cheap" and "not cheap"). This is interpreted as the lower limit of the range of acceptable prices.
- **Point of Marginal Expensiveness (MEP):** Above this price point, there are more respondent that consider the price as "too expensive" than there are respondents who consider it as "not expensive" (intersection of "not expensive" and "too expensive"). This is interpreted as the upper limit of the range of acceptable prices.
- **Indifference Price Point (IDP):** The same number of respondents perceives the price as "cheap" and "expensive" (intersection of "cheap" and "expensive"). In van Westendorp's interpretation, this is either the median price paid in the market or the price of an important market-leader.
- **Optimal Price Point (OPP):** The same number of respondents perceives the product as "too cheap" and "too expensive" (intersection of "too cheap" and "too expensive"). van Westendorp argues that this is the value for which the respondents' resistance against the price is particularly low.

Besides those four intersections, van Westendorp's article advises to analyze the cumulative distribution functions for steep areas which indicate price steps.

To analyze trial rates and estimate revenue forecasts, Newton/Miller/Smith have extended van Westendorp's original model by adding two purchase intent questions that are asked for the respondent's "cheap" and "expensive" price. The purchase probability at the respondent's "too cheap" and "too expensive" price are defined as 0. The main logic is that the "too expensive" price point is prohibitively expensive for the respondent and a price at the "too cheap" price level raises doubts about the product quality.

By combining the standard van Westendorp questions with those two additional purchase intent questions, it becomes possible to summarize the purchase probabilities across respondents (using linear interpolation for the purchase probabilities between each respondent's cornerstone prices). The maximum of this curve is then defined as the price point with the highest expected trial rate. Moreover, by multiplying the trial rate with the price, it also becomes possible to estimate a price with the highest expected revenue.

It has to be noted that the van Westendorp Price Sensitivity Meter is useful in some cases, but does not answer every pricing-related question. It may be a good tool to assess very broadly if the consumers' price perceptions exceed the actual production costs. For more complex analyses (e.g. defining specific prices for different products to avoid cannibalization and drive at the same time incremental growth), other methodological approaches are needed.

## Value

The function output consists of the following elements:

data_input:	data.frame object. Contains the data that was used as an input for the analysis.
validated:	logical object. Indicates whether the "validate" option has been used (to exclude cases with intransitive price preferences).
invalid_cases:	numeric object. Number of cases with intransitive price preferences.
total_sample:	"numeric" object. Total sample size of the input sample <i>before</i> assessing the transitivity of individual price preferences.
data_vanwestendorp:	data.frame object. Output data of the Price Sensitivity Meter analysis. Contains the cumulative distribution functions for the four price assessments (too cheap, cheap, expensive, too expensive) for all prices.
pricerange_lower:	numeric object. Lower limit of the acceptable price range as defined by the Price Sensitivity Meter, also known as <b>point of marginal cheapness</b> : Intersection of the "too cheap" and the "not cheap" curves.
pricerange_upper:	numeric object. Upper limit of the acceptable price range as defined by the Price Sensitivity Meter, also known as <b>point of marginal expensiveness</b> : Intersection of the "too expensive" and the "not expensive" curves.
idp:	numeric object. <b>Indifference Price Point</b> as defined by the Price Sensitivity Meter: Intersection of the "cheap" and the "expensive" curves.
opp:	numeric object. <b>Optimal Price Point</b> as defined by the Price Sensitivity Meter: Intersection of the "too cheap" and the "too expensive" curves.
NMS:	logical object. Indicates whether the additional analyses of the Newton Miller Smith Extension were performed.
data_nms:	data.frame object. Output of the Newton Miller Smith extension: calibrated mean purchase probabilities for each price point.
pi_scale:	data.frame object. Shows the values of the purchase intent variable and the corresponding calibrated purchase probabilities as defined in the function input for the Newton Miller Smith extension.
price_optimal_trial:	numeric object. Output of the Newton Miller Smith extension: Estimate for the price with the highest trial rate.
price_optimal_revenue:	numeric object. Output of the Newton Miller Smith extension: Estimate for the price with the highest revenue (based on the trial rate).

## References

Van Westendorp, P (1976) "NSS-Price Sensitivity Meter (PSM) – A new approach to study consumer perception of price" *Proceedings of the ESOMAR 29th Congress*, 139–167. Online available at <https://rwconnect.esomar.org/a-new-approach-to-study-consumer-perception-of-price/>.

Newton, D, Miller, J, Smith, P, (1993) "A market acceptance extension to traditional price sensitivity measurement" *Proceedings of the American Marketing Association Advanced Research Techniques Forum*.

Sawtooth Software (2016) "Templates for van Westendorp PSM for Lighthouse Studio and Excel". Online available at <https://www.sawtoothsoftware.com/204-about-us/news-and-events/sawtooth-solutions/1759-templates-for-van-westendorp-psm-for-lighthouse-studio-excel>

## Examples

```
set.seed(42)

# standard van Westendorp Price Sensitivity Meter Analysis
# input directly via vectors

tch <- round(rnorm(n = 250, mean = 5, sd = 0.5), digits = 2)
ch <- round(rnorm(n = 250, mean = 8.5, sd = 0.5), digits = 2)
ex <- round(rnorm(n = 250, mean = 13, sd = 0.75), digits = 2)
tex <- round(rnorm(n = 250, mean = 17, sd = 1), digits = 2)

output.psm.demo1 <- psm_analysis(toocheap = tch,
  cheap = ch,
  expensive = ex,
  tooexpensive = tex)

# additional analysis with Newton Miller Smith Extension
# input via data.frame

pint_ch <- sample(x = c(1:5), size = length(tex),
  replace = TRUE, prob = c(0.1, 0.1, 0.2, 0.3, 0.3))

pint_ex <- sample(x = c(1:5), size = length(tex),
  replace = TRUE, prob = c(0.3, 0.3, 0.2, 0.1, 0.1))

data.psm.demo <- data.frame(tch, ch, ex, tex, pint_ch, pint_ex)

output.psm.demo2 <- psm_analysis(toocheap = "tch",
  cheap = "ch",
  expensive = "ex",
  tooexpensive = "tex",
  pi_cheap = "pint_ch",
  pi_expensive = "pint_ex",
  data = data.psm.demo)

summary(output.psm.demo2)
```

**Description**

summary method for class "psm".

**Usage**

```
## S3 method for class 'psm'  
summary(object, ...)
```

**Arguments**

object            an object of class "psm", usually a result of a call to [psm\\_analysis](#).  
...                further arguments from other methods - will be ignored in the summary

**References**

Van Westendorp, P (1976) "NSS-Price Sensitivity Meter (PSM) – A new approach to study consumer perception of price" *Proceedings of the 29th ESOMAR Congress*, 139–167. Online available at <https://rwconnect.esomar.org/a-new-approach-to-study-consumer-perception-of-price/>.

Newton, D, Miller, J, Smith, P, (1993) "A market acceptance extension to traditional price sensitivity measurement" *Proceedings of the American Marketing Association Advanced Research Techniques Forum*.

**See Also**

A comprehensive description of all elements of an object of class "psm" can be found in [psm\\_analysis](#).  
The generic [summary](#) function.

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